REVIEW

Bridging the Gap Between Evidence and Practice in Venous Thromboembolism Prophylaxis: The Quality Improvement Process

Franklin A. Michota, MD

Section of Hospital Medicine, Department of General Internal Medicine, Cleveland Clinic, Cleveland, OH, USA.

Venous thromboembolism (VTE) is considered to be the most common preventable cause of hospital-related death. Hospitalized patients undergoing major Surgery and hospitalized patients with acute medical illness have an increased risk of VTE. Although there is overwhelming evidence for the need and efficacy of VTE prophylaxis in patients at risk, only about a third of those who are at risk of VTE receive appropriate prophylaxis. To address the shortfall in VTE prophylaxis, the US Joint Commission and the National Quality Forum (NQF) endorse standardized VTE prophylaxis practices, and are identifying and testing measures to monitor these standards. Hospitals in the USA accredited by Centers for Medicare and Medicaid Services to receive medicare patients will need VTE prophylaxis programs in place to conform to these national consensus standards. This review aims to give background information on initiatives to improve the prevention of VTE and to identify key features of a successful quality improvement strategy for prevention of VTE in the hospital. A literature review shows that the key features of effective quality improvement strategies includes an active strategy, a multifaceted approach, and a continuous iterative process of audit and feedback. Risk assessment models may be helpful for deciding which patients should receive prophylaxis and for matching VTE risk with the appropriate intensity of prophylaxis. This approach should assist in implementing the NQF/Joint Commission-endorsed standards, as well as increase the use of appropriate VTE prophylaxis.

KEY WORDS: venous thromboembolism; prevention; prophylaxis; quality improvement.
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INTRODUCTION

In the US, the annual incidence of symptomatic venous thromboembolism (VTE), encompassing deep-vein thrombosis (DVT) and pulmonary embolism (PE), is estimated to exceed 600,000, and there are nearly 300,000 VTE-related deaths annually.[1] VTE poses a major burden on the health care system because of high costs associated with both the initial VTE event and long-term complications, such as recurrent VTE and the postthrombotic syndrome.[2] Hospitalized patients undergoing major Surgery and patients with other medical risk factors have an increased risk for VTE.[3–5] Medical risk factors include: trauma (major or lower extremity), immobility, paresis, malignancy, cancer therapy, previous VTE, increasing age, pregnancy and the postpartum period, acute infectious disease, heart failure, respiratory failure, obesity, and smoking.[3,5] The majority of hospitalized patients have at least 1 risk factor for VTE.

Without measures to prevent the occurrence of VTE (VTE prophylaxis), DVT occurs in 10–40% of medical or general Surgery patients, and in 40–60% of patients after major orthopedic Surgery.[5] Over the past decades, overwhelming evidence for the need and efficacy of VTE prophylaxis in at-risk patients has accumulated.[5,6] Currently, VTE is regarded as the most common preventable cause of hospital death, and the third most common cause of all hospital-related deaths.[6]

Of the 37.8 million inpatients discharged from US acute-care hospitals in 2002, 13.4 million met the criteria for VTE prophylaxis proposed in the evidence-based guidelines issued by the American College of Chest Physicians (ACCP).[5,7] However, passive dissemination of such guidelines does not ensure that patients who are at risk receive the prophylaxis they need, or that patients are given appropriate prophylaxis.[8] A study in 2001 found that of 2,367,362 medically ill patients who had ACCP-defined indications for prophylaxis in 330 hospitals across the US, only 26% had been given prophylaxis. This low prophylaxis rate has not significantly improved, as the prophylaxis rate was 33% in 2004.[9]

An analysis of patient safety practices prepared for the US Agency for Healthcare Research and Quality (AHRQ), based on evidence supporting both impact and effectiveness, found that appropriate use of VTE prophylaxis was the most highly rated of the 79 patient safety practices evaluated.[10] In addition, the cost and complexity of implementing appropriate prophylaxis was low. To address the shortfall in VTE prophylaxis, the US Joint Commission and the National Quality Forum (NQF) are endorsing standardized prophylaxis practices to prevent VTE.[6] They are also identifying and testing measures to monitor these standards, which may become future mandates.

Because hospitals in the US accredited by the Centers for Medicare and Medicaid Services (CMS) for receiving medicare patients will need VTE prophylaxis programs in place to conform to these national consensus standards, a review of the evidence for VTE prophylaxis and methods of prophylaxis—which can be found in the ACCP guidelines[5]—is beyond the scope of this

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article. Instead, the objectives of this review are: 1) to give background information on quality improvement (QI) strategies and current initiatives at regulation and policy level to improve the prevention of VTE; and 2) to identify key features of a successful QI strategy for prevention of VTE in the hospital through a literature review, taking into account differences between medical and surgical patients and differences between hospital types.

A BACKGROUND TO QI STRATEGIES FOR VTE PREVENTION

Joint Commission Initiative

The need to prevent VTE in peri- and postoperative surgical patients has been accepted at regulation and policy level, as demonstrated by its inclusion in the Surgical Care Improvement Project (SCIP). SCIP aims to improve the safety of surgical care by reducing postoperative complications, and its measures are being endorsed by the Joint Commission. The SCIP measures include Surgery patients with recommended VTE prophylaxis ordered, and Surgery patients who received appropriate VTE prophylaxis within 24 hours before Surgery to 24 hours after Surgery. Outcome measures include intra- or postoperative PE or DVT diagnosed during the index hospitalization and within 30 days of Surgery.[14]

The importance of VTE prophylaxis and its use in all hospitalized patients is emphasized by its inclusion in the list of 30 evidence-based safe practices for improving patient safety, identified by the NQF and supported by the AHRQ in 2005.[15] Safe practice 17 states that all patients should have their VTE risk assessed at hospital admission and regularly thereafter, and clinically appropriate methods should be used to prevent VTE.[15] Health care institutions are urged to adopt these practices to reduce the risk of patient harm from VTE.

The Joint Commission and the NQF endorse 20 national voluntary consensus standards covering policy, practices, and performance measures related to the prevention and care of VTE (Table 1).[16] A number of performance measures are currently being tested. For VTE prevention, they include: documentation of VTE risk assessment and prophylaxis within 24 hours of hospital admission; documentation of VTE risk assessment and prophylaxis within 24 hours of transfer to ICU, and recording the incidence of potentially preventable hospital-acquired VTE.[6] Once testing is complete, the final recommendations on the performance measures will be published late 2007/early 2008. More information and recent updates can be accessed at the AHRQ, NQF, Joint Commission, and SCIP websites (Table 2).

Thus, hospitals in the US accredited by the Centers for Medicare and Medicaid Services (CMS) for receiving medicare patients will need to identify and implement effective QI strategies for VTE prevention to conform to these national consensus standards.

QI Strategies

A number of QI strategies, whose goal it is to close the gap between evidence-based medicine and routine practice, have shown varying degrees of effectiveness.[11] There are 6 general categories of QI strategies: provider education, provider reminder systems and decision support, audit and feedback, education of patients, organizational change, and financial incentives, regulation, and policy.[11]

The Joint Commission initiative is a QI strategy at regulation and policy level. Little information is yet available on the effects of organizational change and the use of regulation and policy as QI strategies for VTE prophylaxis. The impact of the Joint Commission initiative should become clear after publication of the final performance measures.

Studies dealing with strategies to improve health care quality at the hospital level can be poorly designed; often being simple before-and-after designs at single sites of single institutions. Furthermore, available publications may be biased toward positive results.[11,12] Few direct comparisons of different types of quality initiatives have been undertaken, making it difficult to abstract optimal strategies.[11,12]

In addition, responses to a QI initiative may depend on factors related to the practice, such as the issue being studied and the level of acceptance it has achieved among health care professionals.[13] A study of surgical patients in a 1,200-bed medical center showed that before intervention initiatives (staff meetings, local protocols, etc), only 29% of eligible patients

Table 1. National Quality Forum (NQF)-Endorsed Consensus Standards Relating to Venous Thromboembolism (VTE) Prevention[16]

Consensus standard
Statement of policy
Every health care facility shall have a written policy appropriate for its scope, that is evidence-based and drives continuous QI related to VTE risk assessment, prophylaxis, diagnosis, and treatment.
Preferred practices
General recommendations
Ensure that multidisciplinary teams develop institutions' protocols and/or adopt established evidence-based protocols
Have in place a documented system for ongoing QI that demonstrates acting on evidence-based guidelines/practices (rationale for departing from guidelines should be documented unless documentation itself is for some reason contraindicated)
Include provision for risk assessment/stratification, prophylaxis, diagnosis, and treatment
Include appropriate QI activity/monitoring for all phases of care with periodic (as defined by institutional policy) assessment of compliance with policies and measures
Provide for a system of provider education that encompasses all aspects of VTE prevention and care including primary and secondary prevention, risk assessment and stratification, prophylaxis, diagnosis, treatment and monitoring.
Risk assessment/stratification recommendations
Provide for risk assessments on all patients based on evidence-based institutional policy (institutions have the flexibility to determine how patient risks are assessed/stratified)
Require documentation in the patient's health record that risk assessment/stratification was completed
Prophylaxis recommendations
Provide for type and intensity of prophylaxis based on, and commensurate with, assessment and documentation of risk/benefit and efficacy/safety for the patient
Prophylaxis is based on formal risk assessment and is consistent with nationally accepted, evidence-based measures/guidelines including NQF-endorsed Safe Practice 17 ("Evaluate each patient upon admission and regularly thereafter, for the risk of developing DVT/VTE. Utilize clinically appropriate methods to prevent DVT/VTE").
Performance measures
Surgery patients with recommended VTE prophylaxis ordered
Surgery patients who received appropriate VTE prophylaxis within 24 hours before Surgery to 24 hours after Surgery.

DVT, deep-vein thrombosis; QI quality improvement

Table 2. Websites with More Information and Recent Updates on the Joint Commission Initiative

Organization	Specification	Website
AHRQ	Home page	http://www.ahrq.gov
	Patient safety practices report	http://www.ahrq.gov/clinic/ptsafety/pdf/ptsafety.pdf
	30 Safe practices	http://www.ahrq.gov/qual/30safe.pdf
NQF	Homepage	http://www.qualityforum.org
	Safe practices	http://www.qualityforum.org/projects/completed/safe_practices.asp
	National Consensus Standards VTE	http://www.qualityforum.org/projects/ongoing/vte/index.asp
Joint Commission	Homepage	http://www.jointcommission.org
	Performance measurement initiative	http://www.jointcommission.org/PerformanceMeasurement/VTE.htm
SCIP	Surgical Care Improvement Project	http://www.cfmc.org/hospital/hospital_scip.htm

AHRQ, Agency for Healthcare Research and Quality; NQF, National Quality Forum; SCIP, Surgical Care Improvement Project; VTE, venous thromboembolism

received appropriate anticoagulation prophylaxis to prevent VTE, whereas after the intervention initiative, 50% received appropriate prophylaxis ($P<.001$).[13] However, in this same population, the same intervention initiatives had no effect on the use of beta-blockers to prevent peri-operative cardiac events and beta-blocker use remained very low.

QI STRATEGIES FOR VTE PREVENTION

Method of Literature Review

A systematic review by Tooher et al.[8] including studies published between 1996 and May 2003 was used as a basis to identify studies on QI strategies for VTE prevention. Additional studies between May 2003 and May 2006 were identified with multiple MEDLINE searches. A comprehensive list of search terms was applied (including—but not limited to—thrombosis, thromboembolism, prophylaxis, prevention, quality, improvement, implementation, intervention, strategy, guideline, adherence, and campaign). The titles and abstracts of yielded articles in English were examined. Articles were excluded if the content was not relevant to the topic. The reference list of key articles was also searched for relevant articles. This review provides a comprehensive, but not exhaustive, overview of the current literature on QI strategies for VTE prevention.

Active QI Strategies

Although guidelines on VTE prophylaxis have long been available,[5] the publication of guidelines alone (passive dissemination) as a QI strategy does not ensure the appropriate use of VTE prophylaxis.[8,17–19] A recent review cited 6 studies that relied on the passive dissemination of guidelines to change VTE prophylaxis—no more than half of the patients received appropriate prophylaxis.[8] For example, a study of 1,128 hospitalized medical patients in 2 UK hospitals found that a presentation of international guidelines to hospital staff did not increase prophylaxis rates (28% versus 31% after presentation, $P=.59$).[19]

However, dissemination of guidelines as part of an active strategy does improve their implementation.[20–22] A strategy that involves developing and disseminating local-hospital guidelines may be more effective than passive dissemination of national or international guidelines.[21,22] In a Scottish district general hospital, after the development or upgrading of local prevention protocols, the proportion of patients at risk of developing VTE ($n=224$) who were prescribed prophylaxis in accordance with national guidance rose from 73% to 97% ($P<.001$), and the proportion receiving appropriate prophylaxis rose from 55% to 96% ($P<.001$).[21] In another hospital, an educational program to promote the hospital's guidelines increased the proportion of surgical patients ($n=250$) receiving appropriate prophylaxis from 59% to 70% ($P<.05$), and the

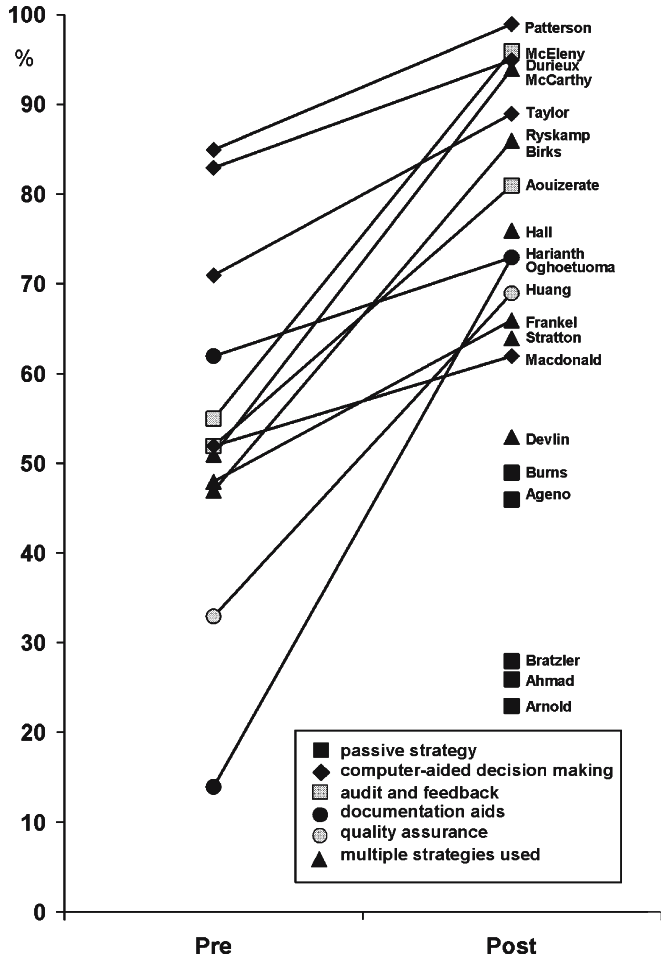

Figure 1. Proportion of patients receiving adequate prophylaxis pre- and postimplementation of the prophylaxis strategy. The slope of the line indicates the extent of improvement—steeper lines indicate greater improvement.[8] Reproduced with permission (Tooher R., et al. Ann Surg. 2005;241:397–415)

proportion of high-risk patients receiving appropriate prophylaxis from 25% to 77% ($P<.05$).[20] This program involved presentations to staff, posters placed around the hospital, dissemination of baseline results, and the distribution of a card summarizing the guidelines.

Several studies have investigated the use of active strategies and a recent systematic review by Tooher et al.[8] included such studies from 1996 to May 2003, (Fig. 1). Since May 2003, additional studies, mainly involving strategies combining provider education or reminders with decision support, have been published. These studies generally show statistically significant increases in the proportion of patients receiving prophylaxis after the adoption of a QI strategy (Table 3).[13,23–30]

Provider Education

Provider education is the basis of a number of QI initiatives, and involves educational meetings that address: the dissemination of guidelines; literature reviews of the scope, risk factors, and asymptomatic nature of VTE; the importance of risk assessment or stratification; the need to provide adequate VTE prophylaxis; the underutilization of prophylaxis; recommended prophylaxis regimens; and local institutional data on VTE prophylaxis before any intervention.[26–30] A pharmacy-driven educational program in a 493-bed US community hospital focusing on the importance of VTE prophylaxis in medically ill patients increased the use of prophylaxis from 43% to 58% ($P<.001$), of suitable prophylaxis from 38% to 49% ($P=.006$), and of optimal prophylaxis from 11% to 44% ($P<.001$). The educational program comprised live educational presentations and newsletters and involved nursing staff, house staff, pharmacists, and physicians.[28] The Joint Commission consensus standards include the provision of a provider education system that encompasses all aspects of VTE prevention. Provider awareness and knowledge of VTE, and its prevention should be starting points of any QI initiative.

Table 3. Studies of Quality Improvement (QI) Strategies in Venous Thromboembolism (VTE) Prophylaxis*

Study (*N*)	Patient group	Hospital type	QI strategy	Elements	Result outcome	Percent of patients		*P* value
						No QI	QI	
Kucher et al.[23] (2,506)	Medical and surgical	Teaching, tertiary	Provide a reminder and decision support	Electronic alerts linked to prophylaxis guideline	Prophylaxis Symptomatic VTE	14.5 8.2	33.5 4.9	<.001 .001
Mosen et al.[24] (4,170)	Surgical	Teaching, community	Provide reminder and decision support	Computerized reminder	Prophylaxis Symptomatic VTE	89.9 1.0	95.0 1.2	<.0001 NS
Grupper et al.[13] (1,051)	Surgical	Teaching, community, referral	Provide education, decision support	Staff meetings, development of local protocols, academic detailing by a nurse	Adequate prophylaxis	29	50	<.001
Khan and Byrne[25] (200)	Gynecologic (C-section)	Teaching	Provide a reminder and decision support, audit	Risk assessment checklist	Appropriate prophylaxis in low- + moderate-risk patients	43	79	–
Stinnett et al.[26] (287)	Medical	Teaching, tertiary	Provide education, decision support	Educational sessions, forms with VTE risk stratification and prevention regimens	Prophylaxis in high-risk patients (low-risk patients)	43 (31)	72 (64)	NA
Cohn et al.[27] (312)	Medical	Teaching, urban	Provide education, decision support, audit and feedback	Staff meetings, pocket cards, posters, monthly audits	Appropriate prophylaxis	43	85	<.01
Dobesh and Stacy[28] (641)	Medical	Teaching, community	Provide education	In-service presentations, newsletters, Q&A presentations Involvement of pharmacists	Optimal prophylaxis	11	44	<.001
Ruttiman et al.[29] (1,308)	Medical	Tertiary	Decision support	Introduction of explicit criteria derived from VTE guideline	Symptomatic VTE	1.7	1.4	NS
Labarere et al.[30] (678)	Medical	Teaching	Provide education, decision support, audit and feedback	Educational presentation, dissemination of materials, feedback on practices, pocket card, posters	VTE (asymptomatic and symptomatic)	9.5	3.2	<.01

*Studies published May 2003–May 2006 after the systematic review by Tooher R, et al.[8]
NA, not available; NS, not significant

Provider Reminder and Decision Support

In most VTE-prophylaxis improvement studies, provider education has been combined with provider reminders, and decision support. Reminder posters can be used to reinforce information from educational sessions,[27,30] but the effectiveness of using this passive method alone has not been tested. An active reminder was a shared element of the most effective QI initiatives identified by Tooher et al[8]; active reminders consist of either paper-based reminders or a computer-based alert. Providers can be reminded that a risk assessment and prophylaxis decision needs to be made by attaching standard sheets to charts/admission forms. However, the forms should be readily accessible, and a system of checks and follow-up should exist to ensure that they are completed; this is crucial during the form introduction phase.[31,32] For example, during the introduction of risk-factor assessment-protocol sheets in a UK surgical department, only a third of forms were completed. After completion checking by nursing staff was initiated, 96% of the forms were completed,[32] emphasizing that an active attitude is the key to QI initiative success. An example of an accessible risk assessment sheet is shown in Figure 2.

Computerized reminders seem to be especially effective.[23,24,33] In a study of hospitalized medical and surgical patients (n=2,506), a computer program was linked to the patient database to identify those at-risk patients not prescribed prophylaxis. The physician received an electronic alert about the risk of VTE for the active intervention group, but not the control group. The physician had to acknowledge the alert and could then withhold or order prophylaxis. The alert system not only increased the use of prophylaxis from 14.5% to 33.5% (P<.001), but also reduced symptomatic DVT or PE 90 days postoperatively by 41% (P=.001).[23] In another reminder system study for patients undergoing major operations (n=2,077), the prophylaxis rate increased from 90% to 95% after implementation (P<.0001).[24] However, in this case, the rate of symptomatic DVT, PE, and death attributable to PE remained unchanged (1% versus 1.2% after intervention; odds ratio [OR] 1.21, 95% CI 0.67–2.20).

Decision support can also be linked to computerized alerts. This can be providing simple links to local guidelines for VTE prevention[23] or providing computer-assisted decision making, where the computer system alerts the physician to any discrepancy between the prescription ordered and the patient data based on guideline criteria[33]. The use of the latter decision-support system for postorthopedic Surgery patients (n=1971) increased compliance with VTE prophylaxis guidelines from 83% to 95% (P<.001). Computer-based decision

Step 1: Exposing risk factors associated with clinical setting

Assign 1 Factor	*Assign 2 Factors*	*Assign 3 Factors*	*Assign 5 Factors*
□ Minor surgery	□ Major surgery* □ Immobilizing plaster cast □ Medical or surgical patients confined to bed >72 hours □ Central venous access	□ Myocardial infarction □ Congestive heart failure □ Severe sepsis/infection	□ Elective major lower extremity arthroplasty □ Hip, pelvis, or leg fracture □ Stroke □ Multiple trauma □ Acute spinal cord injury

Baseline risk factor score (if score = 5, go to step 4): ___

Step 2: Predisposing risk factors associated with patient

	Assign 1 factor unless otherwise noted	
	Molecular	
Clinical setting	*Inherited*	*Acquired*
□ Age 40 to 60 years □ Age over 60 (2 factors) □ History of DVT/PE (3 factors) □ Pregnancy or postpartum (<1 month) □ Malignancy (2 factors) □ Varicose veins □ Inflammatory bowel disease □ Obesity (>20% ideal body weight) □ Combined oral contraceptive/ hormonal replacement therapy	□ Factor V Leiden/activated protein C resistance (3 factors) □ Antithrombin III deficiency (3 factors) □ Protein C and S deficiency (3 factors) □ Dysfibrinogenemia (3 factors) □ Homocysteinemia (3 factors) □ 20210A prothombin mutation (3 factors)	□ Lupus anticoagulant (3 factors) □ Anitphospholipid antibodies (3 factors) □ Myeloproliferative disorders (3 factors) □ Disorders of plasminogen and plasmin activation (3 factors) □ Heparin-induced thrombocytopenia (3 factors) □ Hyperviscosity syndromes (3 factors) □ Homocysteinemia (3 factors)

Total additional predisposing risk factors score: ___

Step 3: Total risk factors (exposing + predisposing): ___

Step 4: Recommended prophylactic regimens for each risk group

Low Risk (1 Factor)	*Moderate Risk (2 Factors)*	*High Risk (3-4 Factors)*	*Highest Risk (5 or More Factors)*
No specific measures	LDUFH (every 12h), LMWH, IPC and GCS†	LDUFH (every 8h), LMWH, and IPC	LMWH, oral anticoagulants, IPC‡ (+LDUFH or LMWH), GCS† (+LDUFH or LMWH)
Early ambulation		GSC† (+LDUFH or LMWH)	Adjusted dose heparin

* Operations in which the dissection is important ot that last longer than 45 minutes, including laparoscopic procedures.
† Combining GCS with other prophylactic methods (LDUFH, LMWH, or IPC) may give better protection.
‡ Data show benefit of plantar pneumatic compression in orthopedic total joint arthroplasty and leg trauma and can be used when IPC is not feasible or tolerated.

Figure 2. Example of a risk-assessment model.[34] Reproduced with permission (Caprini RA, et al. Semin Hematol. 2001;38(2 Suppl 5):12–19). LDUFH, low-dose unfractionated heparin; IPC, intermittent pneumatic compression; GCS, graduated compression stockings

support systems appear to be very effective strategies for improving prescribing practice, presumably because they minimize individual clinician error.[8] However, computerized entry systems are not widespread, therefore decision support can take the form of pocket cards providing information on risk factors and prophylaxis options.[27,30] The provision of risk assessment or stratification, as well as prophylaxis, that is based on accepted guidelines is a consensus standard endorsed by the NQF/Joint Commission.

Risk assessment models that address the needs of hospitalized surgical and medical patients,[34],or just medical patients have been developed.[35] The process of using a risk-assessment model may increase physician awareness of, and vigilance for, risk factors.[35] The Second Thromboembolic Risk Factors Consensus Group proposed a risk assessment model that used a scoring system to stratify both surgical and medical patients into 4 risk categories, based on clearly defined clinical categories (e.g., age group or pregnancy), as well as the presence of specified risk factors; prophylaxis recommendations for each category were also included.[34] However, a simple risk-assessment model developed for medical patients[35] adopted an algorithm approach rather than a scoring system. In addition, available evidence-based consensus guidelines for VTE prevention are regularly updated by the ACCP[5] and the International Consensus Statements/International Union of Angiology groups.[36]

Audit and Feedback

Tooher et al.[8] identified the use of an iterative process of audit and feedback to improve or refine an implementation strategy. Audit and feedback can produce the Hawthorne effect, in which physicians improve their prophylaxis practice because they are aware that individual behavior is measured. Practically, audit and feedback may consist of regular (e.g., monthly) audits by division chiefs to evaluate the type and suitability of VTE prophylaxis prescribed to patients with feedback to the physicians on their patients' VTE risk groups, and the appropriateness of prophylaxis.[27] The Joint Commission consensus standards include monitoring care with periodic assessment of compliance with policies and measures.

An initial audit of surgical patients in a busy district general hospital found that only 51% of 195 patients received appropriate prophylaxis.[31] After the introduction of a risk-factor assessment sheet, a second audit showed that only 37% of patients had a completed risk-assessment sheet, and only 54% (of 59 patients) had received appropriate prophylaxis. This prompted the authors to make the assessment sheet more accessible (by using a scaled-down version on the reverse of a standard prescription sheet), and to initiate a reminder system that required nursing staff to make regular checks for completion. A third audit after these modifications found that 97% of 203 patients had a risk assessment form, and that 94% of these patients had received appropriate prophylaxis. To confirm the results, the same system was introduced in a rural hospital, and 200 patients were audited. The combined results of the 2 hospitals showed that 93% of patients had the miniforms attached to their prescription charts and 90% of these patients had received appropriate prophylaxis. The development of this effective system demonstrates the importance of the audit and feedback cycle.

Multifaceted QI Strategies

A multifaceted intervention including several active strategies is more likely to be effective than a single active strategy used in isolation.[8,11] A combined strategy should help physicians remember to assess the VTE risk status of patients, and assist them in prescribing appropriate prophylaxis.[8] Byrne et al.[31] found it was by using a combination of a more accessible assessment sheet and asking the nursing staff to provide reminders that considerable improvement in the provision of prophylaxis was achieved. As indicated in Table 4, QI strategies are not time-consuming[27] and require only a few hours a month of health care workers' time.

QI INITIATIVES FOR PREVENTING VTE IN SURGICAL OR MEDICAL PATIENTS

The practice of VTE prophylaxis seems more broadly accepted for surgical patients than medical patients,[7,37] although the majority of medical patients (60–75%) have a high VTE risk.[26,27] In a prospective registry of 5,451 patients with confirmed DVT, fewer medical patients received prophylaxis compared with surgical patients (32% versus 48%),[37] suggesting that QI interventions are particularly important for medical patients. A prospective study of the impact of continuing medical education and quality assurance programs on the use of VTE prophylaxis showed that statistically significant increases in the use of prophylaxis occurred in both medical and surgical patients in response to the interventions. However, the increases were significantly greater for surgical patients (OR 7.1, 95% CI 4.7–10.8) than for medical patients (OR 2.0, 95% CI 1.4–2.9).[7]

Table 4. Time/effort Required for Educational Program Elements in the Study by Cohn SL, et al.[27]

Element	Time/effort required
Orientation of all incoming house staff by the Chief Resident on the first day of every month with respect to VTE risk factors and the need to provide adequate prophylaxis	10 min/month
Introduction of pocket cards containing information on VTE risk factors and prophylaxis options	5 min/month
In-hospital education of nurses by the nurse educator	2 sessions of 1hr each
Display of large posters presenting VTE risk-factors and prophylaxis at nursing stations and physician charting rooms	5 min (one time only)
Monthly audits by the Division Chief of General Internal Medicine to evaluate the type and suitability of VTE prophylaxis prescribed	2 hrs/month for interviews 2 hrs/month for record review/data entry

VTE, venous thromboembolism

In the Tooher et al. review, most of the QI studies were performed in surgical patients.[8] However, several more recently published initiatives have focused on medical patients[26–30] (Table 3). A highly successful multifaceted strategy for improving appropriate VTE prophylaxis in medical patients combined education, dissemination of a decision support tool, and regular audit-and-feedback for resident physicians.[27] Rates of appropriate prophylaxis increased from 43% to 85% 18 months after implementation of the program ($P<.01$).[27] Optimal QI initiatives need not differ between surgical and medical patients, but perhaps more emphasis is needed on educating physicians of the importance of risk assessment and VTE prophylaxis in hospitalized medical patients.

In surgical patients, VTE risk is assessed for patients having certain types of Surgery. Total knee, hip replacement, and hip fracture surgeries are associated with a very high risk of VTE, and therefore warrant prophylaxis in all patients, regardless of individual patient VTE risk factors. In other types of Surgery, the need for prophylaxis depends on individual patient risk factors, and the intensity of prophylaxis that is recommended

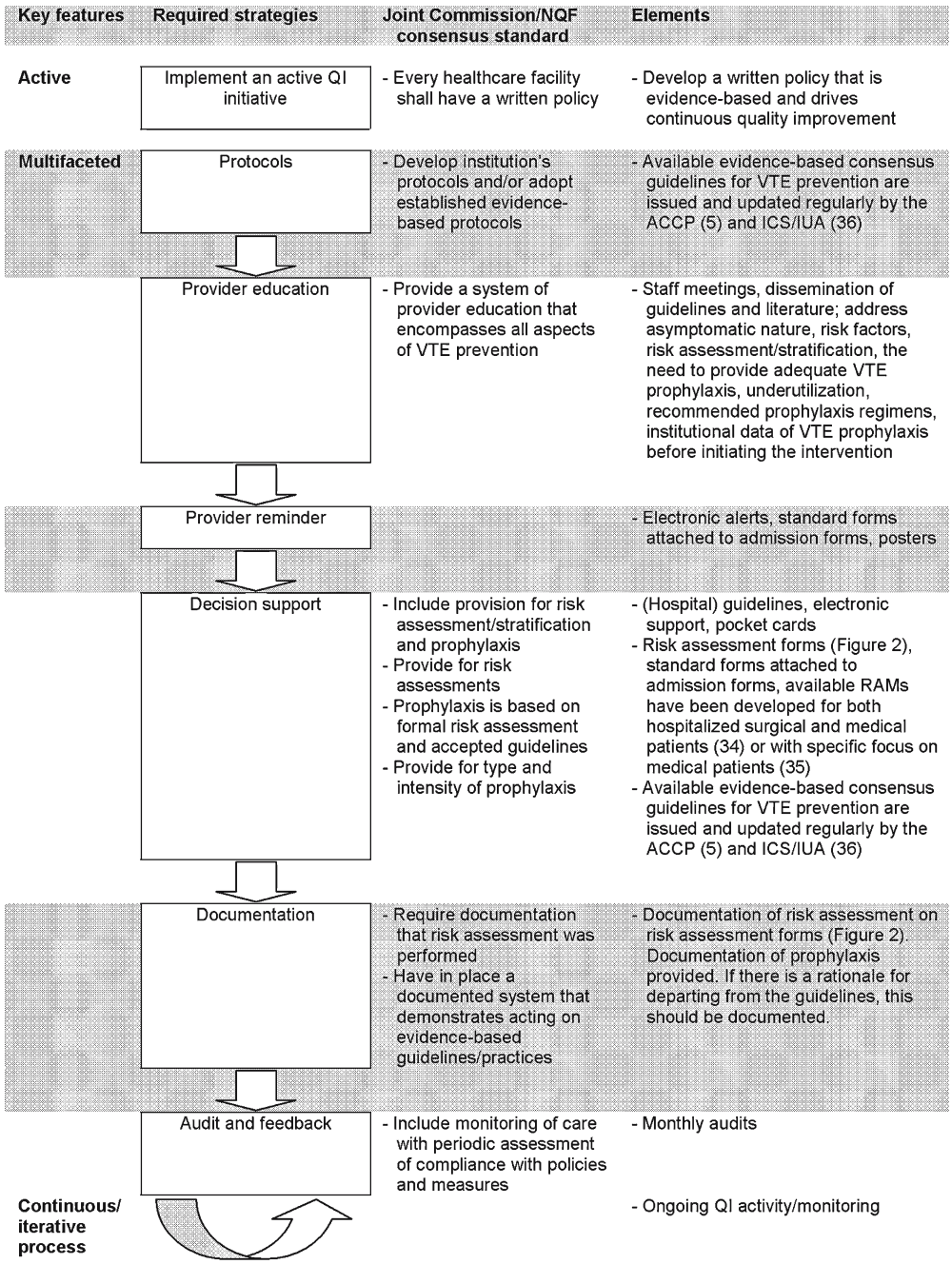

Figure 3. Key features and example elements to improving venous thromboembolism (VTE) prophylaxis according to the Joint Commission/ National Quality Forum (NQF)-endorsed consensus standards. ACCP, American College of Chest Physicians; ICS, International Consensus Statements; IUA, International Union of Angiology; QI, quality improvement; RAMs, risk assessment models

reflects the level of risk. Uncertainty among physicians with respect to identifying medical patients at risk for VTE may result in the underuse and overuse of prophylaxis.[38] In a study of 1097 patients, 44.9% of medical patients who should have received prophylaxis based on the study's predefined criteria did not, whereas 41.3% received prophylaxis unnecessarily.[38] Although the overall hospitalized medical patient population has a moderate to high VTE risk,[27] it is a heterogeneous group of patients with different VTE risk levels. Certain groups of medical patients (e.g., those with stroke, myocardial infarction, congestive heart failure) have a particularly high VTE risk and all such patients should receive pharmacological prophylaxis, irrespective of their individual VTE risk factors, unless contraindicated. In lower-risk medical patients, the type and intensity of prophylaxis should be determined based on the patients' individual risk factors. A number of risk assessment models are available for medical patients that stratify them according to individual risk and facilitate the use of appropriate thromboprophylaxis.[23,34,35] The Joint Commission standards include the evaluation of VTE risk and the use of appropriate measures to prevent VTE for all patients on hospital admission.

QI INITIATIVES FOR PREVENTING VTE: INFLUENCE OF HOSPITAL TYPE

QI initiative studies for improving VTE prophylaxis have been performed almost exclusively in teaching hospitals (Table 3). In a study involving 112 patients eligible for prophylaxis in 2 Italian hospitals, prophylaxis was prescribed for 58% of those in the teaching hospital, but only 33% of those in the nonteaching hospital (P=.0067); suggesting that prophylaxis rates in medical patients may be lower in nonteaching hospitals than in teaching hospitals.[39] However, a retrospective study of data from 3,818 acute care hospitals in the US from 1990–1996 reported higher incidence rates of postoperative symptomatic VTE/PE in teaching hospitals (0.51%) than in nonteaching hospitals (0.35%, P<.001).[40] Thus, there does not appear to be a systematic difference in VTE prophylaxis practices between hospital types. The implementation of a QI strategy will need to account for differences between hospitals in terms of resources, organizational factors, and the availability of specialized care and staff. Larger hospitals will generally have more resources to implement QI strategies. However, the NQF/Joint Commission-endorsed performance measures will need to be applied across all hospitals receiving medicare patients accredited by CMS.

SUMMARY: KEY FEATURES OF A QI STRATEGY

Based on the literature reviewed, the key features of an effective strategy for improving VTE prevention are an active strategy, a multifaceted approach, and a continuous iterative process of improvement. The multifaceted approach should begin by developing institutional protocols or by adopting established evidence-based protocols. Provider awareness and knowledge of all aspects of VTE and its prevention should be enhanced by education. Reminding the provider that VTE risk should be assessed greatly enhances the practice of prescribing appropriate prophylaxis in eligible patients. Risk assessment forms and protocols for provision of prophylaxis, including type and duration, should be available to support the decisions of the provider. Group or individual risk-assessment models can assist in identifying eligible medical patients and in matching the degree of prophylaxis with VTE risk. Documentation of each step is important to demonstrate that a VTE prevention program is in place. Completing and repeating the audit and feedback cycle allows development of the optimal program for each hospital. Hospitals in the US accredited by the CMS to receive medicare patients will need to have VTE prophylaxis programs in place to conform to the NQF/Joint Commission-endorsed national consensus standards. The key features of such a program and example elements are illustrated in Figure 3, which may assist the implementation of the NQF/Joint Commission-endorsed standards and improve the use of appropriate VTE prophylaxis.

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Corresponding Author: *Franklin A. Michota, MD; Section of Hospital Medicine, Department of General Internal Medicine, Cleveland Clinic, S70/9500 Euclid, Avenue, Cleveland, OH 44195, USA (e-mail: michotf@ccf.org).*

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